INSTRUCTION MANUAL

101/102/ 103

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PRECISION Standards CORP.
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POWER SUPPLY

MODEL 101-102-103

S.N. 1148

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SECTION 1

SPECIFICATIONS

SPECIFICATIONS MOD 101

OUTPUT RANGE:
Constant voltage: 0 to 50 volts
Constant current: 0 to 0.4 amps

OUTPUT IMPEDANCE:
DC to 100 Hz: Less than 0.02 ohms
100 Hz to 1 KHz: Less than 0.4 ohms
1 KHz to 1 MHz: Less than 2 ohms

RIPPLE AND NOISE:
Constant voltage: Less than 200 microvolts rms
Constant current: Less than 10 microamps rms

LINE REGULATION:
Constant voltage: Less than 0.005%±1 mv for 105 to 130 volts rms change
Constant current: Less than 0.005%±20 microamps for 105 to 130 volts rms change

LOAD REGULATION:
Constant voltage: Less than 0.01%±5 millivolts
Constant current: Less than 0.05%±50 microamps

OVERLOAD PROTECTION:
Automatic crossover, voltage-to-current or current-to voltage

TRANSIENT RECOVERY TIME:
Constant voltage: Less than 100 microseconds
Constant current: Less than 10 milliseconds

REMOTE PROGRAMMING:
Constant voltage: 0.5k ohms/volt or 0.1 volts/volt
Constant current: 5k ohms/amp or 2.5 volts/amp

TEMPERATURE COEFFICIENT:
Constant voltage: 0.05%/°C±1 millivolt
Constant current: 0.1%/°C±500 microamps

OPERATING TEMPERATURE:
Range 0 to 50°C

INPUT:
105 volts rms, 28 watts, to 130 volts rms, 35 watts
50 to 60 Hz

SPECIFICATIONS MOD 102

OUTPUT RANGE:
Constant voltage: 0 to 20 volts
Constant current: 0 to 1 amp

OUTPUT IMPEDANCE:
DC to 100 Hz: Less than 0.01 ohms
100 Hz to 1 KHz: Less than 0.2 ohms
1 KHz to 1 MHz: Less than 2 ohms

RIPPLE AND NOISE:
Constant voltage: Less than 150 microvolts rms
Constant current: Less than 25 microamps rms

LINE REGULATION:
Constant voltage: Less than 0.005% ±1 mv for 105 to 130 volts rms change
Constant current: Less than 0.005% ±50 microamps for 105 to 130 volts rms change

LOAD REGULATION:
Constant voltage: Less than 0.01% ±2 millivolts
Constant current: Less than 0.05% ±125 microamps

OVERLOAD PROTECTION:
Automatic crossover, voltage-to-current or current-to-voltage

TRANSIENT RECOVERY TIME:
Constant voltage: Less than 75 microseconds
Constant current: Less than 10 milliseconds

REMOTE PROGRAMMING
Constant voltage: 1.25k ohms/volt or 0.25 volts/volt
Constant current: 2k ohms/amp or 1 volt/ amp

TEMPERATURE COEFFICIENT:
Constant voltage: 0.05%/°C ±400 microvolts
Constant current: 0.1%/°C ±1.25 milliamps

OPERATING TEMPERATURE:
Range 0 to +50°C

INPUT
105 volts rms, 30 watts, to 130 volts rms, 40 watts, 50 to 60 Hz

SPECIFICATIONS MOD 103

OUTPUT RANGE:
Constant voltage: 0 to 10 volts
Constant current: 0 to 2 amps

OUTPUT IMPEDANCE:
DC to 100 Hz: Less than 0.005 ohms
100 Hz to 1 KHz: Less than 0.1 ohms
1 KHz to 1 MHz: Less than 2 ohms

RIPPLE AND NOISE:
Constant voltage: Less than 100 microvolts rms
Constant current: Less than 50 microamps rms

LINE REGULATION:
Constant voltage: Less than 0.005% ±1 mv for 105 to 130 volts rms change
Constant current: Less than 0.005% ±100 microamps for 105 to 130 volts rms change

LOAD REGULATION:
Constant voltage: Less than 0.01% ±1 millivolts
Constant current: Less than 0.05% ±250 microamps

OVERLOAD PROTECTION:
Automatic crossover, voltage-to-current or current-to-voltage

TRANSIENT RECOVERY TIME:
Constant voltage: Less than 50 microseconds
Constant current: Less than 10 milliseconds

REMOTE PROGRAMMING:
Constant voltage: 2.5k ohms/volt or 0.4 volts/volt
Constant current: 1k ohms/amp or 0.5 volts/amp

TEMPERATURE COEFFICIENT:
Constant voltage: 0.05%/°C ±200 microvolts
Constant current: 0.1%/°C ±2.5 milliamps

OPERATING TEMPERATURE:
Range 0 to +50°C

INPUT:
105 volts rms, 30 watts, to 130 volts rms, 40 watts, 50 to 60 Hz

SECTION 2

GENERAL INFORMATION

2.1 INSPECTION

When the unit is received, the customer should inspect it for any shipping damage. Remove the top cover of the unit to inspect the printed circuit boards. The printed circuit boards should be removed, inspected and replaced in their proper slots, one at a time. The component side of each board should be facing the front of the module. Do not alter the controls on the printed circuit boards; if any control is moved, the unit will be out of calibration.

2.2 SHIPPING KIT

The shipping kit should be inspected when the unit is received and should include the following:

One power cord
One set of unassembled patch pins
One shorting bar

2.3 MOUNTING

MOD power sources are designed to be used as single power units or incorporated with other MODS into optional racks.

NOTE: Before installing the modules into racks, remove the handles. This is done by removing the black screws at both ends of the handle.

2.4 CONNECTORS

A 3-pin connector is used for the AC power input. Connections are provided on the front panel and the rear patchboard connector for ground and the plus (+) and minus (-) outputs. The rear patchboard also provides all additional connections for remote programming and sensing.

2.5 PATCH PIN ASSEMBLY

The shipping kit contains a set of unassembled patch pins. Figure 2-1 shows the proper way to assemble the patch pins.

2.6 INITIAL OPERATION

Prior to the application of power, insure that the unit is protected by a fuse located at the rear of the module.

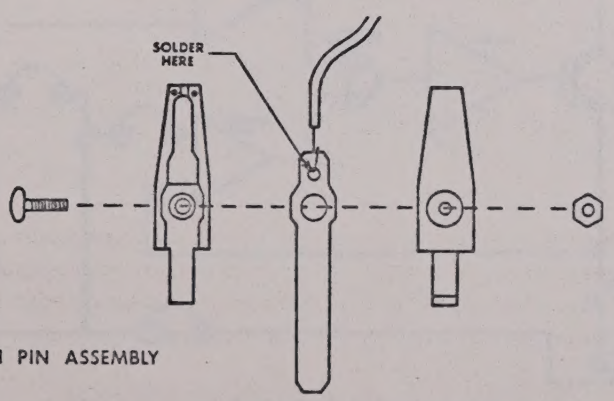
The unit is programmed for normal operation by the patch cords at the rear patchboard connector at the factory. These patch cords should not be removed until another mode of operation is desired.

Plug the AC line cord into a 115 volt 60 Hz source and turn the POWER switch to the ON position. Set the METER switch to VOLT and observe the front panel meter. Insure that the voltage can be controlled in a range from zero volts to the maximum rated output voltage of the unit.

Set the METER switch to CUR and short the power supply output. Insure that the current can be controlled in a range from zero amperes to the maximum output current of the unit.

2.7 COOLING

For proper operation, the air surrounding the unit should be maintained between 0°C and +50°C, with a relative humidity not to exceed 70%. When racks are used, it is recommended that flushing fans be used (MOD fan module).



PATCH PIN ASSEMBLY

SECTION 3

THEORY OF OPERATION

MOD power sources are all-silicon voltage and current regulated modules. The units are designed to operate on a line voltage ranging from 105 to 130 volts AC at a line frequency ranging from 50 to 60 Hz.

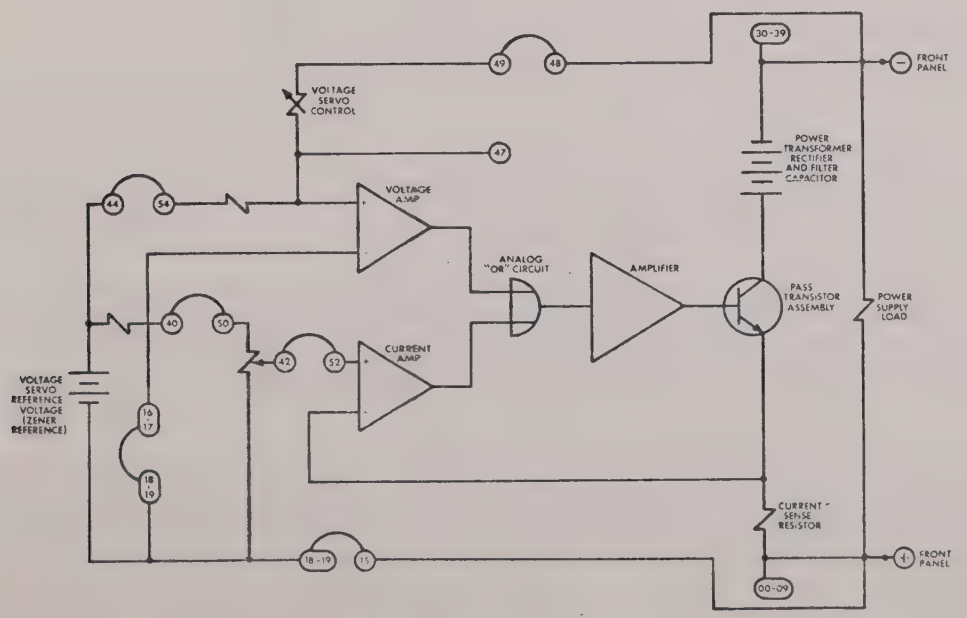
The power source consists of six basic elements: (1) the power transformer, rectifier and filter, (2) an auxiliary DC supply, (3) a reference, with voltage and current amplifiers, (4) the automatic crossover circuit, (5) an optional overvoltage crowbar circuit, and (6) the series control element.

The line voltage is connected to the primary of transformer T1; the output of secondary No. 1 of T1 is connected to an AC-to-DC conversion unit. The conversion unit consists of a fullwave bridge rectifier and a large capacitor. The positive (+) output is connected to the positive output terminal via the series control element. The negative (-) output is connected directly to the negative output terminal.

The auxiliary DC supply power is supplied by secondary No. 2 of transformer T1 and rectified by a full-wave bridge and filtered by capacitor C3. The auxiliary DC supply provides a regulated plus (+) 13 volts and minus (-) 13 volts (with respect to the positive (+) output of the unit) to the regulator board.

The regulator board consists of a voltage and current reference, two low-drift differential amplifiers (one for voltage and one for current), an analog OR circuit, and a driver amplifier for the series control element. The voltage servo is connected in an operational configuration and the current servo is connected in a potentiometric configuration. The analog OR circuit provides automatic crossover from voltage-to-current and current-to-voltage regulation. The most negative voltage to the two inputs of the analog OR circuit determines the mode of regulation. The supply may operate in both modes simultaneously if the inputs to the analog OR circuit are of an equal magnitude.

The optional overvoltage crowbar circuit consists of an adjustable level detector and a silicon controlled rectifier (SCR). The purpose of the overvoltage crowbar is to protect external equipment from possible power supply failure or the operator from truning the voltage up too high. When the voltage reaches a pre-selected point the SCR is turned on and the output of the supply is short-circuited. In order to return the supply to normal operation, adjust the voltage control to zero volts and then back to the desired voltage.



MOD POWER SUPPLY BLOCK DIAGRAM
FIGURE 3-1

SECTION 4

OPERATING INSTRUCTIONS

4.1 NORMAL FRONT PANEL OPERATION

For "normal operation" (front panel operation): Jumper between 15 and 16, 17 and 18, 40 and 50, 42 and 52, 44 and 54, 48 and 49; as shown in Figure 4-1.

The MOD Power Supplies, as shipped from the factory, are wired for "normal" power supply operation. The metal strap on the front panel binding posts should be connected between the chassis ground and the low side of the power supply to reduce the output noise. In the "normal" power supply operating mode, the sense leads are connected to the front panel binding posts. The unit, when in operation, will function as a constant voltage power supply at the voltage set by the front panel voltage control knobs. As the output or load current is increased, the unit will automatically crossover to a constant current mode of operation. The point of crossover from constant voltage to constant current is set by the current control knobs on the front panel. To obtain the best regulation in the constant current mode of operation, the meter switch should be in the "current" position. (Note: The meter can draw up to 100 microamps from the power supply output current if the meter switch is in the VOLTAGE position. This will reduce the degree of current regulation by 100 microamps.)

To set the constant current point, set the meter switch to "current," short the output terminals of the supply together and adjust the current control knobs for the required current as indicated by the meter.

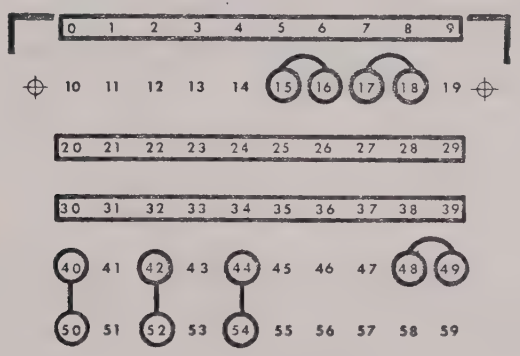


FIGURE 4-1

4.2 EXTERNAL VOLTAGE SENSE

For external voltage sense: Jumper between 17 and 18, 40 and 50, 42 and 52, 44 and 54; 16 is (+) sense lead, 49 is (-); see Figure 4-2.

The sense leads must be connected to the correct polarity at the load. The sense leads will draw less than 2 milliamps, but a finite voltage drop will occur in the sense leads due to the sense current. Adequate precautions should be taken with regard to the sense lead length and wire size based on 2 milliamps of sense current and the degree of voltage regulation required at the load. The voltage drop between the output of the power supply and the load should not exceed 1 volt.

In order to minimize noise pickup in the sense leads, they should either be twisted together or shielded. The low side of the power supply should be connected to chassis ground either at the front panel or the rear panel. If rear panel connection is desired, connect a jumper between Pin 20 (20 through 29) and the low output side of the power supply, Pin 00 (00 through 09) for (+) voltage, or Pin 30 (30 through 39) for (-) voltage.

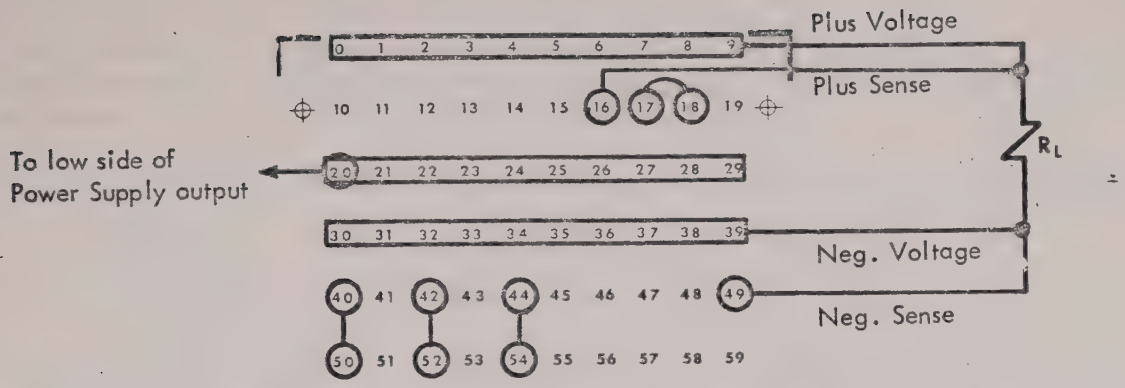


FIGURE 4-2

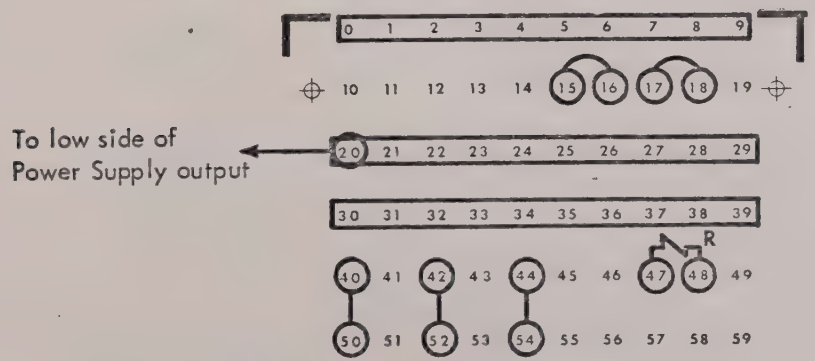
4.3 VOLTAGE PROPORTIONAL TO RESISTANCE

Voltage proportional to an external resistance value: Jumper between 15 and 16, 17 and 18, 40 and 50, 42 and 52, 44 and 54; connect external resistor between 47 and 48; see Figure 4-3 .

The external resistance is connected between Pin 47 and the negative supply voltage; i.e., Pin 48 for front panel operation. The connection from the external resistance to the negative supply voltage is the (-) sense lead. The output voltage will change according to the value of external resistance used as shown below:

MOD 101	MOD 102	MOD 103
0.5k ohms/volt	1.25k ohms/volt	2.5k ohms/volt

The accuracy of the output voltage versus resistance is ±10%. Greater accuracy (±1%) can be obtained by recalibrating the power supply internally. This is accomplished by connecting the desired resistance to the power supply and adjusting Pot R-23 on the first plug-in printed circuit board for the absolute voltage required. If a switch is used to select external resistance values, a make-before-break switch should be used. If the resistor is momentarily removed from the circuit, the output of the supply will increase, momentarily, to its maximum output voltage. In order to minimize noise pickup in the leads to the external resistor, the leads should be twisted or shielded. The low side of the power supply output should be connected to ground.



Lead going to No. 48 is (-)
Neg. sense lead (in this configuration)

FIGURE 4-3

4.4 VOLTAGE PROPORTIONAL TO VOLTAGE REFERENCE

Voltage proportional to an external control voltage: Jumper between 18 and 54, 40 and 50, 42 and 52, 48 and 49; connect 15 and 19 to (+) side of reference voltage; connect 17 to (-) side of reference voltage; see Figure 4-4.

The output voltage will change according to the value of external control voltage as shown below:

MOD 101	MOD 102	MOD 103
0.1 volts/volt	0.25 volts/volt	0.4 volts/volt

To calibrate the unit, apply the required control voltage for full supply output voltage and adjust the front panel voltage control knobs for the specified output voltage from the supply. The input resistance, as seen by the external control voltage source, is greater than 1 megohm. The source resistance of the external control voltage source should be less than 1k ohms to obtain the specified power supply stability. Precautions should be taken to avoid pickup in the external leads. The low side of the power supply output should be connected to ground.

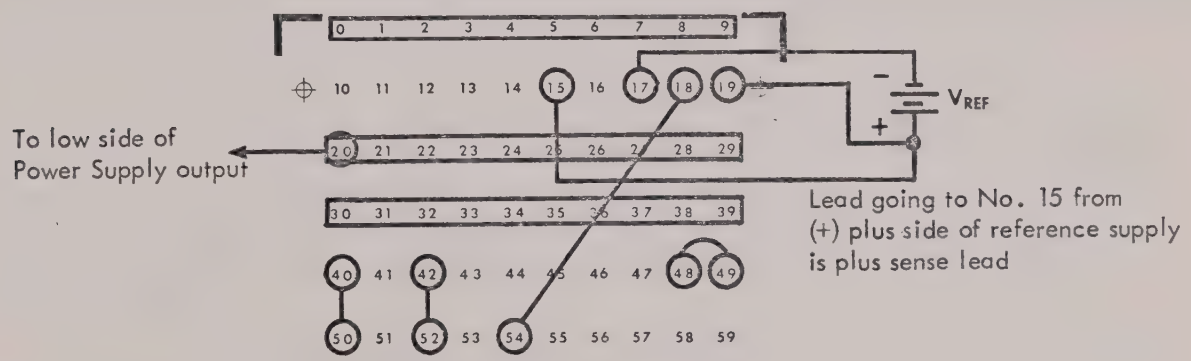


FIGURE 4-4

4.5 CURRENT PROPORTIONAL TO RESISTANCE

Current proportional to an external resistance value: Jumper between 15 and 16, 17 and 18, 44 and 54, 48 and 49; connect 40 and 52 to one side of resistor and 19 to other side; see Figure 4-5.

MOD 101	MOD 102	MOD 103
5k/amp	2k/amp	1k/amp

The accuracy of the output current versus resistance is ±10%. Greater accuracy can be obtained by recalibrating the power supply internally. This is accomplished by connecting the desired resistance to the power supply and adjusting Pot R-22 on the first plug-in printed circuit board for the absolute current required. The output current versus resistance is slightly non-linear, but will vary less than ±10% from the best straight line drawn through the response curve. If a switch is used to select external resistance values, a make-before-break switch should be used. If the resistor is removed from the circuit, or too large a value is selected, the power supply will not be short-circuit current limited and may be destroyed.

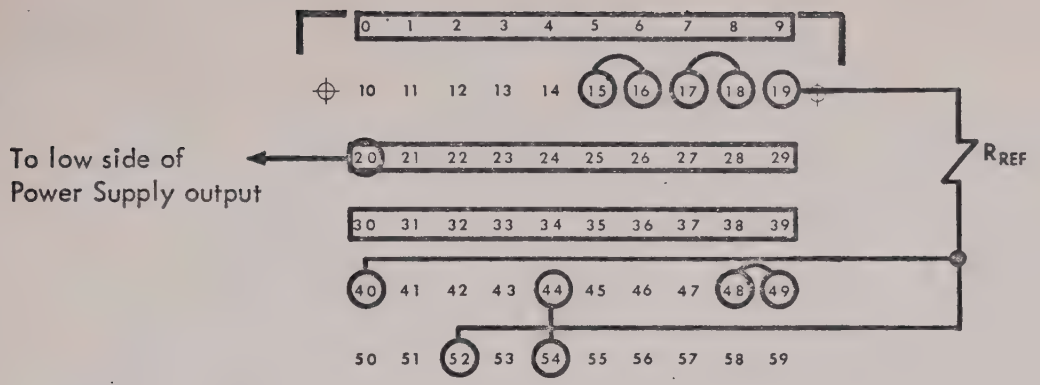


FIGURE 4-5

4.6 CURRENT PROPORTIONAL TO VOLTAGE REFERENCE

Current proportional to an external control voltage: Jumper between 15 and 16, 17 and 18, 40 and 50, 44 and 54, 48 and 49. Connect 52 to (+) side of reference voltage; connect 19 to (-) side of reference voltage; Figure 4-6.

The accuracy of the output current versus external control voltage is ±2% of the rated supply current. The input resistance, as seen by the external control voltage source, is greater than 1 megohm. The source resistance of the external control voltage source should be less than 1k ohms to obtain the specified power supply stability. If the external control voltage exceeds the specified value, the power supply will not be short-circuit current limited and may be destroyed.

Precautions should be taken to avoid pickup in the external leads. The low side of the power supply output should be connected to ground.

MOD 101	MOD 102	MOD 103
2.5v/amp	1v/amp	0.5v/amp

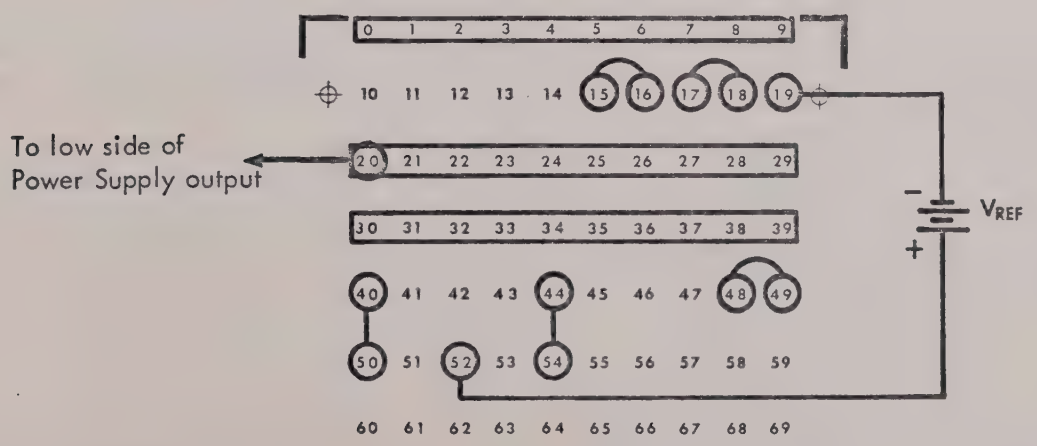
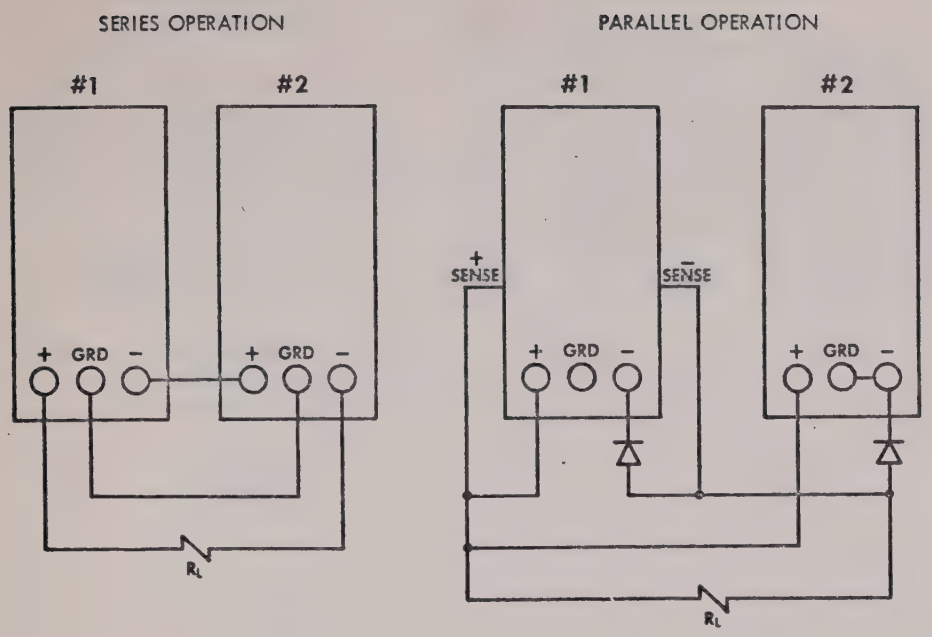


FIGURE 4-6



REAR PATCH CONNECTIONS

#1	#2
16(+ Sense)	15 to 16
17 to 18	17 to 18
40 to 50	40 to 50
42 to 52	42 to 52
44 to 54	44 to 54
49(−Sense)	48 to 49

Diodes are 1N1191R or equivalent

SERIES AND PARALLEL OPERATION OF ~ MOD POWER SUPPLIES

SECTION 5

REGULATION AND RIPPLE CHECK

1. Connect the power supply AC input to metered variac or variable auto-transformer.

2. Connect load resistor to the output terminals of the power supply through a switch and DC ammeter. The load resistor should be such that the rated load current is obtained with rated output voltage.

3. Connect a differential voltmeter or digital voltmeter DIRECTLY to the power supply output terminals. The differential voltmeter must not be connected to the load or to the wires going to the load.

4. Connect an AC vacuum tube voltmeter with shielded leads to the output terminals of the power supply.

5. LOAD REGULATION:

   a. Adjust the variac for 115 volts as indicated by the variac.

   b. Close load switch and adjust load resistor for rated output current as indicated by the DC ammeter, with the power supply output set at rated voltage.

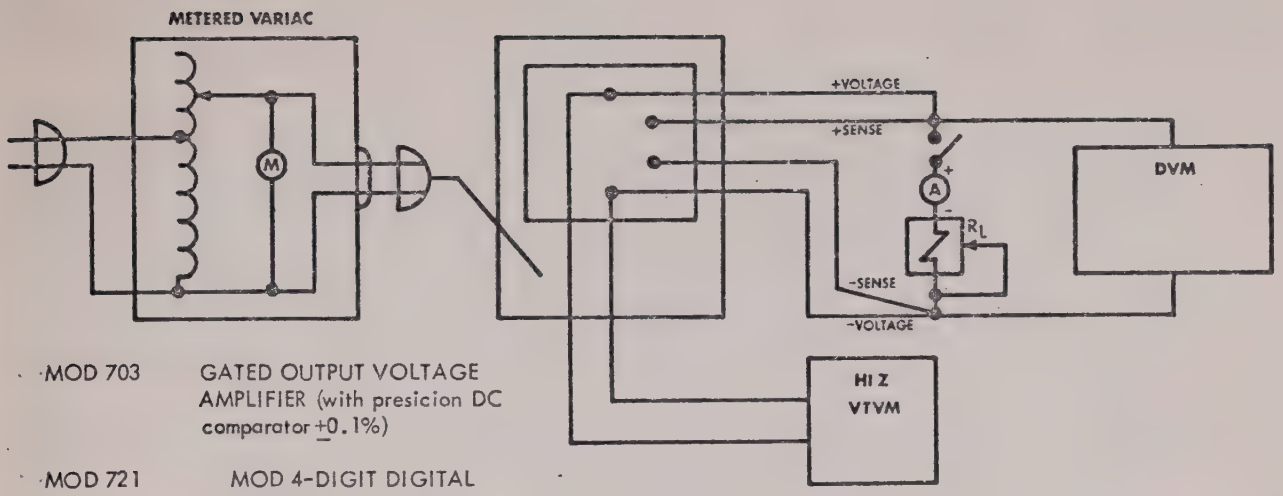
   c. The load regulation can be measured by alternately opening and closing the switch and observing the voltage change on the differential voltmeter.

6. LINE REGULATION:

   With rated output current SW1 closed, vary the line voltage as indicated by the variac from 105 to 130 volts AC. The line regulation can be observed on the differential voltmeter.

7. RIPPLE:

   With the AC input voltage set at 115 volts, rated output current and voltage, the ripple may be observed on the AC vacuum voltmeter or other low bandwidth HI input impedance voltmeter.



MOD 703 GATED OUTPUT VOLTAGE AMPLIFIER (with presicion DC comparator ±0.1%)

MOD 721 MOD 4-DIGIT DIGITAL VOLTMETER

TEST SETUP FOR REGULATION AND RIPPLE

SECTION 6
CALIBRATION

1. With Power Supply turned OFF, zero the meter movement on the front panel.
2. Turn on power and set the meter switch to VOLTAGE.
3. Connect 1% Voltmeter to plus (+) and minus (-) output terminals on the power supply.
4. Set Voltage Controls on front panel for maximum output voltage.
5. Adjust trim pot R23 within the power supply for the maximum rated voltage output of the unit.
6. Adjust trim pot R-2 such that the meter on the front panel is the same as the 1% Voltmeter reading.
7. Reduce the output voltage of the unit and set the CURRENT/VOLTAGE switch to CURRENT.
8. Connect a 1% ammeter to the output terminals of the power supply.
9. Adjust the Current Controls on the front panel for maximum current output.
10. Adjust trim pot R-22 within the unit for the maximum rated output current of the unit.
11. Adjust trim pot R-1 for the same current readings on the front panel meter and the test ammeter.

SECTION 7

TROUBLE SHOOTING

Prior to trouble shooting the supply, it should be returned to the normal mode of operation as described in Section 4, paragraph 4.1 of this manual. Insure that the patch pins are properly placed as shown in Figure 4-1, and that there are no extra patch pins in the Patch Board Connector.

If the unit operates as it should when it is programmed as described in Section 4, paragraph 4.1, return the unit to the desired mode of operation carefully following the Figure which describes the desired mode of operation.

If the supply continues to malfunction check for broken patch pin wires and broken wires within the unit.

7-1 LOAD AND LINE REGULATION OUT OF SPECIFICATION: PROBABLE CAUSE:

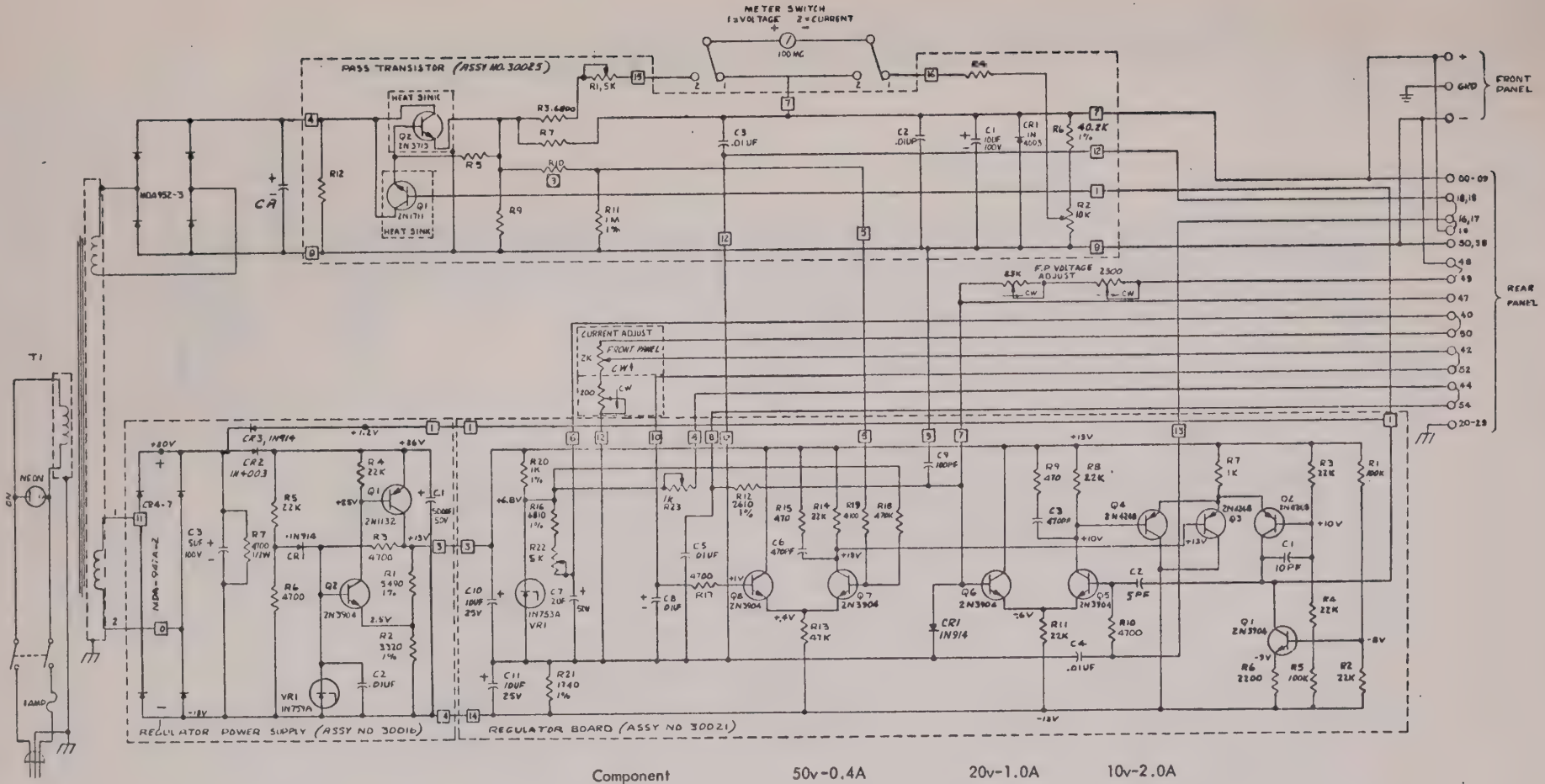
a. Differential voltmeter improperly hooken up. (see Section 5)
b. A. C. input voltage below minimum operating value. Check A. C. input voltage at power supply input terminals.
c. Supply in current limiting mode. Check load current.

7-2 HIGH OUTPUT VOLTAGE:

a. Shorted series regulator transistor.
b. Shorted driver transistor.

7-3 INPUT FUSE BLOWS:

a. Rectifiers may be shorted.
b. Filter or output capacitors may be shorted
c. Possible shorted turn in transformer



Component	50v-0.4A	20v-1.0A	10v-2.0A
R-12	10k-1/2w	4.7k-1/2w	2.2k-1/2w
R-9	2.2k-2w	1k-2w	470ohms-2w
R-7	2.5ohm 1%-2w	1ohm1%-2w	1ohm1%-2w
R-4	475k 1%	191k 1%	95.3k 1%
CA	1,500uf@75V	4,000uf@30V	8,000uf@20V
R-10	component value to be selected in test		

SECTION 9

SPARE PARTS LIST

Box No.	Description	Value or Part No.	Quantity
50	Capacitor	5 pf	1
52	Capacitor	10 pf	1
62	Capacitor	100 pf	1
72	Capacitor	470 pf	2
93	Capacitor	0.01 uf	6
116	Capacitor	2 uf, 50 v	1
135	Capacitor	5 uf, 50 v	1
142	Capacitor	10 uf, 25 v	2
143	Capacitor	10 uf, 100 v (101 only)	1
154	Capacitor	500 uf, 50 v	1
234	Diode	1N753A	1
237	Diode	1N759A	1
239	Diode	1N914	1
244F	Diode	1N3156	2
245	Rectifier Bridge	MDA952-3	1
245A	Rectifier Bridge	MDA942-2	1
285A	Indicator Lamp		1
345F	Potentiometer	CTS V-201, 1K (101 only)	1
349	Potentiometer	CTS V-201, 5K	1
382A	Resistor	2 w, 1 ohm, 1% (101-102)	1
395	Resistor	1/4 w, 86.6 ohms, 1% (101 only)	1
397	Resistor	1/4 w, 100 ohms, 1% (102 only)	1
409	Resistor	1/4 w, 1K, 1%	1
420	Resistor	1/4 w, 1740, 1%	1
429	Resistor	1/4 w, 2610, 1% (101 only)	1
436B	Resistor	1/4 w, 8320, 1%	1
446	Resistor	1/4 w, 5490, 1%	1
450	Resistor	1/4 w, 6340, 1% (102 only)	1
451	Resistor	1/4 w, 6810, 1%	1
468	Resistor	1/4 w, 29.4K, 1% (103 only)	1
473	Resistor	1/4 w, 49.4K, 1%	1
477A	Resistor	1/4 w, 95.3K, 1% (103 only)	1
478A	Resistor	1/4 w, 191K, 1% (102 only)	1
483A	Resistor	1/4 w, 475K, 1% (101 only)	1
488	Resistor	1/4 w, 1meg, 1% (102 only)	1
30814	Potentiometer	30814	1
30815	Potentiometer	30815	1

Assembled Spare Boards

Pre-regulator Board	1
Pass Transistor Board	1
Regulator Board	1

SECTION VI

WARRANTY

The PRECISION STANDARDS CORPORATION warrants each instrument to be free from defects in material and workmanship. The instrument must be returned to the factory with shipping prepaid and a complete report of the difficulty. This warranty is good for one year from the shipping date.

SHIPPING DAMAGE

If there is any damage to the instrument upon receipt, report this to the transportation claim agent immediately.

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1028411